

PASSENGER CONVEYOR DRIVE MONITORING ARRANGEMENT WITH BRAKE ACTUATION

1. Field of the Invention

5 This invention generally relates to passenger conveyor drive systems. More particularly, this invention relates to an arrangement for monitoring the operative condition of a passenger conveyor drive system and for actuating a brake as may be needed.

10 2. Description of the Related Art

Escalator systems typically include a chain of steps that moves along a loop to carry passengers between landings in different levels of a building, for example. Most escalator systems include at least one drive machine that propels the steps in the desired direction. In many cases, a drive sprocket engages a step chain, which is
15 associated with the steps to cause the desired step movement. Other passenger conveyors have similar or identical arrangements although the steps may move passengers horizontally.

More recently, new drive arrangements have been proposed or introduced. With the introduction of such new systems, the need arises for new techniques for
20 monitoring the operation of the drive system to ensure appropriate performance. Additionally, escalator safety codes require brake actuation in the event of a damaged or failing drive arrangement and new drive systems require new techniques for appropriately actuating a brake.

This invention addresses the need for monitoring the condition of a drive
25 assembly and actuating a brake as may be needed in a passenger conveyor drive arrangement that includes a drive member for moving the step chain.

SUMMARY OF THE INVENTION

In general terms, this invention is a drive assembly monitoring technique that
30 utilizes relative speeds of sheaves or sprockets as an indication of the condition of the drive assembly.

One example drive assembly includes a plurality of drive wheels. A drive member such as a belt is associated with each drive wheel. Each drive member follows a path around the associated drive wheel and at least one deflection wheel. A monitor device is associated with selected wheels to provide an indication of relative rotation between the selected wheels.

In one example, when there is a difference in the speed of rotation of the selected wheels, the monitor device provides an indication of such relative rotation and facilitates actuating a brake to prevent the steps from moving. In one example, the relative rotation between the sheaves indicates a broken drive member.

One example monitor device includes a first rotating member that is coupled to rotate with the first one of the selected wheels. A second rotating member is coupled to rotate with a second one of the selected wheels. The first and second rotating members begin in a first axial position and remain in that position while the selected wheels rotate at the same speed. At least one of the rotating members moves to a second position responsive to relative rotation between the selected wheels. In one example, the rotating member moves axially relative to the other rotating member when there is a speed difference between the sheaves and, therefore, the rotating members.

As one of the rotating members moves responsive to the speed difference, that movement in one example operates an actuator that, in turn, actuates a brake associated with the escalator system.

The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 schematically illustrates, in perspective view, selected portions of an escalator system including a drive assembly designed according to an embodiment of this invention.

Figure 2 is a perspective, schematic illustration of an example drive assembly designed according to an embodiment of this invention.

Figure 3 illustrates, in somewhat more detail, selected portions of the embodiment of Figure 2.

Figure 4 shows the embodiment of Figure 3 in a second operating position.

Figure 5 is a perspective, schematic illustration of another example drive
5 assembly designed according to an embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 schematically shows an escalator system 20 having a plurality of steps 22 that move between landings 24 and 26 in a generally known manner. The
10 steps 22 follow a track (not illustrated) that is supported as part of an escalator truss structure 28. A step chain 30 includes a plurality of links 32 that are associated with the steps 22 so that movement of the step chain 30 causes movement of the steps 22.

In the example of Figure 1, a drive assembly 40 includes a drive member 42 that interacts with the links 32 of the step chain 30 to cause the desired movement of
15 the steps 22. The drive member 42 in one example is a polyurethane belt having reinforcing members such as steel cords. In another example, the drive member 42 comprises a chain. For discussion purposes, the drive member 42 will be referred to as a belt.

As best appreciated from Figure 2, the belt 42 preferably is toothed and
20 follows a path defined by a drive wheel 44 and a deflection wheel 46. A machine (i.e., motor and brake) 48 causes movement of the drive wheel 44, which propels the belt 42 around the path and, in turn, propels the step chain 30 and steps 22 in the desired manner. In an example where the drive member 42 comprises a chain, the wheels 44, 46 comprise sprockets. In some examples where drive belts are used, the
25 wheels comprise grooved sheaves.

Although an escalator is shown and discussed, this invention is not limited to escalators. Moving walkways are another example of the conveyors with which this invention may be used.

Figure 2 schematically illustrates an example drive assembly 40 having two
30 drive members 42. Each drive member 42 is associated with a step chain 30 on the opposite lateral sides of the steps 22. In this example, a machine 48 is associated with each of the drive wheels 44 and the corresponding belts 42. Figure 2 schematically

shows a monitor device 50 that monitors an operating condition of the drive assembly 40. In particular, the monitor device 50 is capable of providing information regarding a condition of the belts 42, such as when one or both of the belts 42 breaks.

5 In this example, the monitor device 50 includes a first rotating member 52 that rotates with a shaft 54, which rotates with the deflection wheel 46. A second rotating member 56 rotates in unison with a shaft 58, which rotates with the other deflection wheel 46. At least one of the rotating members 52, 56 is associated with a brake actuator 60 that operates to actuate a brake 62. The actuator 60 and brake 62 are schematically shown and comprise known components. The brake 62 may be part of
10 the machine brake or an auxiliary, emergency stopping brake, depending on the needs of a particular situation. The actuator 60 may be electric, cable-based or some combination of these. Those skilled in the art who have the benefit of this description will be able to arrange braking components as needed to meet the needs of their particular situation.

15 As best seen in Figure 3, the first rotating member 52 of the example monitoring device 50 is a bushing that rotates with the shaft 54, in unison with rotation of the deflection wheel 46. An engaging surface 64 on the bushing 52 cooperates with a corresponding engaging surface 66 on the second rotating member 56, which also is a bushing in this example. The first rotating member 52 is biased
20 toward the second rotating member 56 such that the engaging surfaces 64 and 66 are aligned as shown in Figure 3. In this example, the engaging surfaces 64 and 66 are at least partially arranged at an oblique angle relative to the axis of rotation of the rotating members 52 and 56. In this example, a spring 68 biases the first rotating member 52 toward the second rotating member 56.

25 Under normal operating conditions, the two deflection wheels 46 will rotate at the same speed because the drive wheels 44 are moving synchronously driving the belts 42 in unison. Under such conditions, the first and second rotating members remain in the first position shown in Figure 3. In the event that one of the belts 42 becomes broken, for example, there will be a difference in the speed of rotation
30 between the deflection wheels 46, because one of them will no longer be driven by the corresponding belt 42 and drive wheel 44. Under these conditions there is relative rotation between the first rotating member 52 and the second rotating member 56.

The inclined engaging surfaces 64 and 66 therefore cause relative axial movement between the first rotating member 52 and the second rotating member 56. One position is shown in Figure 4 where the relative rotation has caused axial movement of the first rotating member 52 relative to the sheave 46 and the second rotating member 56. Such axial movement provides an indication of a malfunction in at least part of the escalator drive system.

In this example, a plate 70 is secured to rotate with the first rotating member 52. As the first rotating member 52 moves axially, the plate 70 causes a follower 72 to move axially as part of the plate 70 is received within a groove 74 on the follower 72. One end 76 of the follower 72 is received to slide within a channel 78 formed on a support 80 as shown. In one example, the support 80 is secured to a selected portion of a drive assembly support structure 82 (Figure 2), which is associated with the escalator truss 28 in a generally known manner.

The axial movement of the follower 72 can be appreciated by comparing the position of the follower 72 with the setting member 84 in Figure 3 and Figure 4. As the follower 72 moves away from the setting member 84, that provides an indication of a malfunction, such as a broken belt condition.

In one example, as the follower 72 moves away from the setting member 84, that triggers the actuator 60 such as throwing a switch (not illustrated) or pulling upon a cable or linkage arrangement (not illustrated) to actuate the brake 62. Those skilled in the art who have the benefit of this description will be able to appropriately arrange the brake actuator portion to cause activation of the brake chosen for their particular situation.

Accordingly, it can be appreciated that the monitoring device 50 provides an indication of a malfunction in the drive assembly, which normally has both belts 42 and all four sheaves 44, 46 rotating at the same speed. In the event that there is any relative rotation between them (i.e., a speed difference between at least two selected wheels), that is an indication of a malfunction in the drive assembly, which may be used to actuate a brake, if desired.

The example embodiment of Figure 2 is useful for indicating when one of the belts 42 becomes broken or damaged, for example. The embodiment of Figure 5 is useful for indicating a situation where either belt 42 is damaged or both of the belts 42

are simultaneously broken or damaged. The latter condition may not be fully appreciable using an embodiment as schematically shown in Figure 2.

Referring to Figure 5, the modified rotating member 56' includes a follower portion 90 that is associated with a connector 92, which causes the follower portion 90 to rotate at the same speed as a pulley 94 associated with a synchronizer bar 96 that rotates in unison with the drive wheels 44. In one example, the follower portion 90 comprises a groove on the second rotating member 56. In another example, the follower portion 90 comprises a separate sheave that is arranged to rotate in unison with at least one of the rotating members 52, 56'.

In this example, a single second rotating member 56' is associated with two first rotating members 52A and 52B. Each of the first rotating members 52A, 52B are associated with a respective one of the deflection wheels 46 to rotate in unison with the associated sheave. In the event that either belt 42 becomes damaged or broken, there will be relative rotation between the drive wheels 44 and the corresponding deflection wheel 46. Under such circumstances, the second rotating member 56' will rotate relative to the corresponding first rotating member 52 (A or B) causing at least one of the rotating members to move axially as described above. This results in operating the actuator mechanism 60, which in turn may operate a brake as needed.

The embodiment of Figure 5 allows for separately monitoring each belt 42 or both belts 42 using a single monitoring device arrangement. If both belts 42 broke simultaneously, there would still be relative rotation between the members 56' and 52A, B.

Another example embodiment includes dedicated first rotating members 52 and second rotating members 56 associated with each deflection wheel 46 and a synchronizing arrangement to cause the rotating members to rotate in unison and at the same speed as the drive wheels 44 under normal operating conditions. Those skilled in the art who have the benefit of this description will realize how to best arrange the components of the monitor device 50 to meet the needs of their particular situation.

The preceding description is exemplary rather than limiting in nature. Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this invention. The

scope of legal protection given to this invention can only be determined by studying the following claims.